FINDING A CINDERELLA FIT FOR FEMALES AND OTHER NEGLECTED PERSONS

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ABSTRACT

Some of the many elements influencing fit in the clothing system are examined in this paper. The general ways that government, industry and consumers have tried to achieve good fit in apparel are outlined. The goal of universal good fit probably will not be achieved with present resources. There is a clear and compelling need for an accurate, representative, and up-to-date measurement description of our population and for a rational, apparel-fit system.

INTRODUCTION

As the story goes the glass slipper fit one female foot so perfectly it was possible to find Cinderella after an exhaustive search of every marriageable female in the land. The Cinderella story tells us about a special foot, a special shoe, and a special maker. From an anthropometric view the Cinderella foot could be described as normal: a foot with width, circumference, instep length and heel width. In only one overall dimension was the foot special: the foot was small enough to slip easily and perfectly into a small slipper, "just as if it were made of wax" (Perrault, 1954). The slipper was made of transparent glass or precious materials, constructed in such a way that standing, walking, dancing, running and testing were possible; material that adapted perfectly to one particular foot. The shoe maker was special, too, for in a moment, a slipper of elegant style, durability and perfect fit was produced.

The Cinderella story is a fairy tale, a creation of dreams and fantasy, an art form in fiction to stir the imagination. Yet, fairy tales offer meanings on many levels (Bettelheim, 1976). In a literal sense Cinderella could be a story of a girl without a fitting party dress and shoes, denied by convention the enjoyment of a royal affair available to everyone else. Clothing created the princess.

How realistic is the desire for the Cinderella fit, not only in shoes, but most articles of ready-to-wear clothing? What resources do we presently have to provide reasonable apparel matches for everyone? What other resources do we need? How can we go about providing for populations differing not only in overall dimensions but in individual ways? These are some of the questions to be explored in this paper. Female fit will be the focus, recognizing apparel fit touches everyone.

BACKGROUND

Apparel production presents special problems in human factors anthropometry not shared by other mass produced items. Technology and products have been adapted to the human shape, to the weight and mass of body parts, to the reach and motion of the body and its parts. Acting on both sides of the human-machine interface, apparel belongs more to the human body system than the machine system (Fourt and Hollies, 1970). Basic automobiles can be identical, but individual apparel items require relatively precise sizes. The automotive industry draws on industry standards designed to accommodate 95% of the driving-riding population. Apparel with the ready-to-wear label must fit theoretically 99% or more of the population. Certain apparel items, such as shoes, have close fit requirements so that considerable size variation must appear in footwear, more than in almost anything a person wears or uses. Some shoe factories produce more than 150 different sizes. Most products move through the manufacturing process with little fit degradation. Virtually every step of apparel production and retailing --from design concept to fitting room actions-- influences fit.

Less than fifty years ago getting a good fit was a serious problem. Apparel manufacturers had individual systems of sizing developed by trial and error methods from unsystematic and unreliable measurement surveys. Size designations were not uniform across manufacturers. Custom tailoring and alterations were necessary to achieve good fit. Informal rule-of-thumb or apprenticeship standards were used, some with colorful histories. For example, shoe standards dating back to a 14th C. decree equated 3 average barleycorns to the inch (Huiskamp, 1956). By barleycorn measure the longest foot (39 barleycorns) became size 13 with a size grading of a barleycorn per size. A curious evolution resulted in a British size system one size longer and wider than the American system. In metric countries a shoe size difference was set at two-thirds centimeter.

The chances of getting a good fit are considerably better today in part due to industry-government cooperation in setting and maintaining voluntary standards (Forziati, 1965). Today the apparel-fit system has a base in body measurement data used by designers and manufacturers, standards available from the government,

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and a general acceptance of available apparel with a tolerance for misfit by the consumer. Good fit requiring little or no alteration is possible for the typical buyer and for the home sewer using commercial patterns. While a good fit in ready-to-wear is probable, today's apparel fit is not a Cinderella fit nor will it be in the immediate future.

ANTHROPOMETRIC STUDIES

The movement to better fit began with a comprehensive anthropometric survey by the U.S. Department of Agriculture of the body dimensions of American women and children (O'Brien and Shelton, 1941). Basic body dimensions needed in garment construction were suggested by apparel manufacturers and pattern companies. Measurement teams took systematic, reliable data from nearly 150,000 children and youth between 4 and 17 and nearly 15,000 women. Joint efforts of the Departments of Agriculture and Commerce resulted in standards for sizing patterns and womens' and childrens' garments (UDC, 1949; 1954). Three types of commercial standards were developed: body measurement, model form, and garment-size. Body measurement standards represented the body in underwear and foundation garments. Model form standards were girth and length modifications of body measurement standards for apparel-fitting purposes. Garment size standards were derived body measurement standards for specific garments. Subsequent standards revisions have been made including a present cooperative effort with the National Bureau of Standards, Proposed Voluntary Product Standard TS 221, Body Measurements for the Sizing of Female Patterns and Apparel, February 22, 1978.

Since the Agricultural Department survey the only large-scale anthropometric surveys of American women have been made of female military populations (Laubach, McConville, Churchill and White, 1977). The latest anthropometric studies of US Army women provide a comprehensive measurement model and a compendium of previous studies (Laubach, McConville, Churchill and White, 1977), an extensive data base and descriptive, functional statistics (Churchill, Churchill, McConville, and White, 1977). Smaller scale studies of less than 50 measurements on 1000 or more women include two civilian populations. Table 1 is a summary of female anthropometric studies.

TABLE 1

Summary of Female Anthropometric Studies

Date	Study Population	N	Data
1939-1940	Civilian women	14,698	59 measurements; 4 made over foundation garments
1942	USAF women	444PT 152N	31 measurements
1946	Army women	8,859	64 measurements
1952	USAF women	852	63 measurements
1959-1962	Civilian women NH Examination	3,581	18 measurements (scientific sample of non-institutional adults, 18-79)
1968	USAF women	1,905	136 measurements; 13 measurements over foundation garments
1971	Airline FA-women	423	72 measurements
1976-1977	Army women	1,331	128 body size dimensions; 14 workspace dimensions; 9 static strength measures

As Table 1 shows, female anthropometric surveys have been marked by differences in target populations, research and sampling techniques, number and kind of measurement approaches. Considerable differences in terminology, measurement landmarks and recording techniques have also been noted, making direct comparisons difficult (Laubach, McConville, Churchill and White, 1977). Despite the limitations, three female anthropometric population descriptions of stature and weight are presented for comparison in Figures 1 and 2.

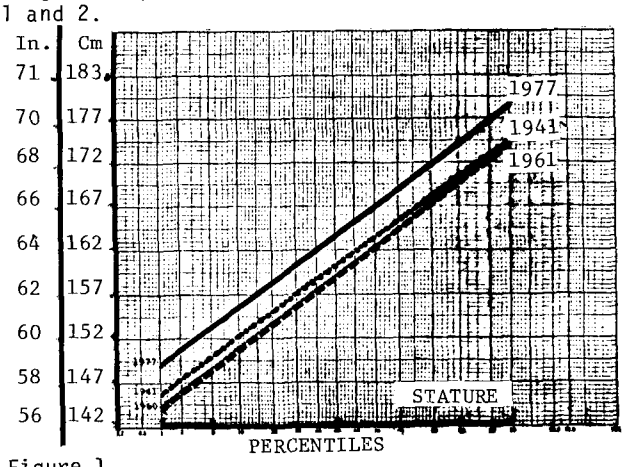

Figure 1 Female Stature Studies

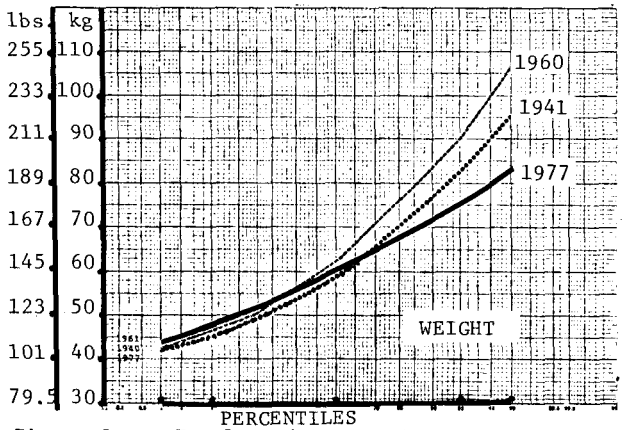

Figure 2 Female Weight Studies

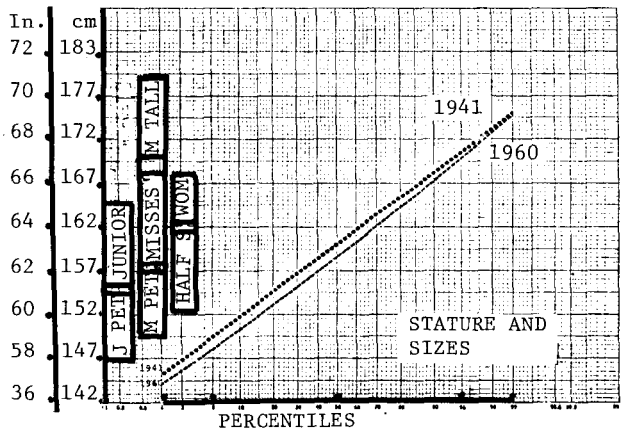

Figure 3 Female Stature and Sizes

The results of three studies of female weight and stature, each separated by a span of about 20 years are confusing. Virtually no change (even a slight decline) in stature appears during the first two decades, then an increase of the magnitude of 3 to 5 cm occurs. This pattern contradicts general findings (Stoudt, 1978). Weight patterns are equally confusing with a slight increase (ranging from 1 to 3 kg for the lightest 50% of the female population) to an increase of 10 kg for those in the top 99% weight group during the first study span. Nearly twenty years later a dramatic decrease of about 20kg occurs for the heaviest group with a 2 kg decrease at the 50 %ile and a pattern matching earlier studies for the lowest weight groups. Whatever the basis for the apparently incongruous patterns, subsequent enterprise can only reflect and augment the confusion.

STANDARDS AND GUIDES

To accommodate female body variations for patterns and apparel purposes, four classifications are provided by voluntary standards: Juniors', Misses', Women's and Half-sizes (shorter women). Further accommodations are supplied by descriptive body types: Petite, Regular, and Tall. Within each classification, bust, shoulder and waistline measurements are lengthened or shortened accordingly. Relationships among stature and weight data from two studies and the nominal size classifications appear in Figures 3 and 4.

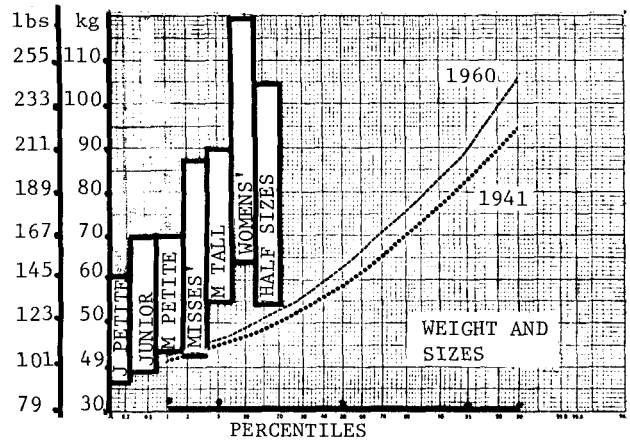

Figure 4 Female Weight and Sizes

As depicted, size classifications cover most stature variations extending to beyond 174 cm (99%-ile) with some size overlap. Size gaps occur for women less than 147 cm (below 2%ile) and for women between 168.5 cm and 170.5 cm. Extensive overlapping occurs for weight variations within size classifications, ranging from less than 35.9 kg (below the 1%-ile) to more than 107 kg (above the 99%-ile). Stature-weight relationships on the order of R=.50 may account for the wide range of weights in each nominal classification (Churchill, Churchill, McConville and White, 1977). All classifications represent women "enhanced by a good-fitting foundation garments without padding (USDC, PS42-70, p. 27).

The conversion of anthropometric data to sizing rules has further modification in grading guides which purportedly reflect factual body growth. Grading guides permit the generation of smaller and larger sizes from an average master pattern. In general, grades for bust, waist and hips of the smaller sizes and body types are 2.54 cm (1 in.) between sizes 3-10. For the larger sizes, 12 1/2 - 18 1/2 and 16-52, grades are 5.08 cm (2 in.) except for waists for 38-52 and 18 1/2. For the in-between

sizes, 9-16, 3.81 cm (1.5 in.) separate the sizes. These grading practices make the size differences smallest in the smallest population groups, with the largest differences between sizes for the largest population groups. The moderate correlations among bust, waist and hip measurements (R=.799 bust and waist; .715 bust and hips; .709 waist and hips (Churchill, 1977) may be the basis for the rule. Another factual basis may be the smaller absolute variability in stature and weight for the smallest female population segments (see Figures 1 and 2) and the larger absolute variability in the largest female segments. The larger grades would also serve to keep the number of sizes within practical limits for manufacturers and retailers.

INDUSTRY PRACTICES

Apparel manufacturers and retailers may or may not use body standards and grading guides. Even though most manufacturers reportedly do not use voluntary standards and guides (Clothes, February 15, 1977) some feedback system is used to create garment specifications. A survey questionnaire of selected major retailers indicates heavy reliance on sales histories, market surveys and buyers merchandising decisions for purchasing and distributing sizes of clothing.

At the apparel factory the designer builds the style and fit-shape of the garment for womens' clothing by draping fabrics on a static model form, a sample size developed from a standard. Following draping, a master pattern is developed, cut, sewn and tested on the model form and a person of the intended size. Once the master pattern is adjusted for fit, found to meet garment specifications, and is graded for other sizes, additional changes may be required by the need to make the best use of fabric yardage in production. The production and finishing processes may also modify the garment by sewing, pressing or finishing techniques. (Solinger, 1961)

CONSUMER

Ultimately the consumer buys some clothing. Most important in the purchase of the garment will be the fit (Lowrey, 1977). Despite the plethora of styles, colors, sizes, fabrics and finishes; despite numerous apparel marketplaces and broad price ranges; despite industry-government standards, guides and labeling requirements, the task will not be easy and the result may not be satisfying. Some of the complexities of the apparel-fit system are shown in Figure 5.

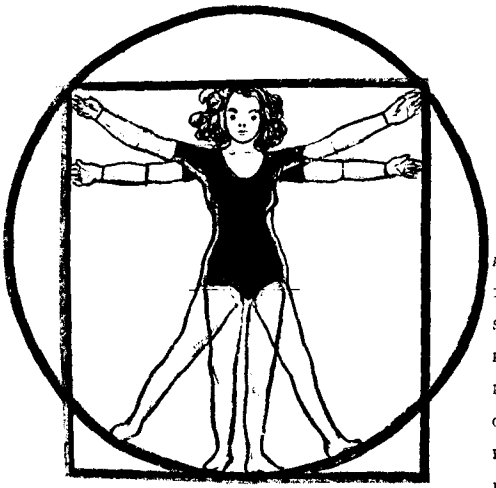

Figure 5 Apparel-fit System

Recently, a totally automated and individualized apparel-fit system was described where every dress would be customized (Rosen, 1978). The system called for computerated design, computerated manufacture and programmable automation. People could design their own clothes--with the help of the computer clothing clone--at a reasonable price.

RECOMMENDED CHANGES

Long before the Cinderella clothing clone arrives some important changes will have to take place in the apparel-fit system. First, comprehensive body measurements will have to be made on a representative population describing females and others as they are today. About 10,000 sets of measurements (one per person) are proposed as necessary to describe a population group such as adult females (AAMA Technical Committee, 1975). Adding junior females, junior males, adult males and infants will bring the total number of needed sets to 50,000. Selected individuals should be tracked anthropometrically for several decades to monitor intra-individual changes in proportions and body configurations due to aging and environmental influences (Croney, 1971). Some dynamic measures should be considered and perhaps, some stereophotogrammetric methods should be used to assist in identifying apparel control dimensions (Roebuck, Kroemer and Thomson, 1975). Second, the apparel-fit system will need to develop ways to describe clothing by important fit dimensions instead of name labels. An ISO proposal (1974) for a tag with bust, waist, and hip dimensions marked on a female pictograph could be useful in reducing size and body type confusions. Third, serious consideration should be given to the adoption of the nearly universal metric system (SI) which promises national and international benefits (AAMA, 1975).

CONCLUSIONS

As a fairy tale the Cinderella story reflects in magic mirror fashion the wishes, needs and desires of our inner world. As the prince we can continue searching about in largely trial-and-error fashion to find a perfect clothing match for ourselves as we are today, knowing the poor odds.

The Cinderella fit eludes most of us today. With current government, industry and customer practices we are closer to the characters in the Procrustes myth. Like the victims of the Greek robber we are either stretched or cut off to fit. Candidate Cinderellas have thus far shown a generous tolerance for misfit, an acceptance for what has been. Unless we are resigned to the fate of Procrustean victims, or worse, of Procrustes himself, we can together call for new, more rational sizing and fitting systems.

Will the magic mirror of tomorrow begin to reflect garments that enhance our living style as well as our looks; clothes that protect from the elements and serve as a system for promoting our comfort; apparel that permits us to function in personal and public roles without concerns about our safety and well-being; shoes and slippers with a Cinderella fit? With widespread awareness, acceptance and support for a national anthropometric survey we can put already sophisticated tools and highly skilled measurement teams to work. From there much will depend on the maturity to develop and conduct reliable, representative and realistic anthropometric studies. Much will depend on mature cooperation among designers, anthropometrists, apparel manufacturers, human factors specialists, and interested national and international groups to make survey and research findings useful. Much will depend on consumer response to new ways of sizing, grading and labeling new apparel-fit systems. Then, perhaps, the Cinderella fit for females and other neglected persons will be fact rather than fiction.

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